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ABSTRACT

Comprehension of the quantifiers "some" and "all" was studied with 202 children, three to nine years old. Thirty-two quantifier sentences dealing with descriptions of circles and squares were presented to the children. Wooden objects were presented to some children to see if results were affected by the choice of abstract objects, but no differences were found. The relationship of "over-interpreting" quantifiers to acquisition was analyzed. "Over-interpretation" is to understand "all" as occupying both possible sentence positions: as a sentence quantifier and as a quantifier in an adjective phrase. Interpretations of "all" as an adverb and as an adjective are analyzed, and deep structure positions and over-interpretation are discussed. "Double-some" sentences, the extensive "some," the intensive "some," reversals, and quantifier order are also discussed. (SW)

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ON THE ACQUISITION OF SOME AND ALL*

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Quantifiers have been a source of puzzles since ancient times. The interaction of all, some, only, every, not, et al. produces an array of subtle implications that, in turn, have produced conundrums, riddles, and syllogisms. Three or four quantifiers in a row is far more difficult to comprehend than three adjectives in a row (e.g. "Not only some of the boxes are deep, dark, solid, and sturdy.") The intricacy with which quantifiers interact (their scope or range) presents not only a problem of linguistic description, but also a problem of psychological complexity that every speaker can recognize.

Some linguists have recently sought to combine logical notation with generative grammar in order to describe quantifiers (McCawley, Karttunen and Dowty, for example). Our approach — which need not be inconsistent with such attempts — is to look at quantifiers in the framework of acquisition studies where diverse systems come into play: syntactic, cognitive, and perceptual. Our approach, like others, is incomplete because it does not deal with all quantifiers. But ours has the virtue of using traditional syntactic formulations to describe quantifier overgeneralizations (which are much like those that have been found already with negation) and perceptual strategies of the kind proposed by Bever.

Our work began with an observation about all. It can be ambiguous:

(1) The circles are all black.

In this sentence all may refer to circles, i.e., all of the circles, or to black, i.e. completely black. (Notice, however, that either reading gives the same truth conditions and that "The circles are black" does, too.)

This ambiguity may result because of the possibility of assigning to (1) two different underlying syntactic representations. In the circles reading we presumably interpret all as a "sentence quantifier" which, following Dougherty,[1] may be generated in the sentence-initial position and then moved into the verb phrase by quantifier-postposing and quantifier-movement rules, as in the structure (2a). The black reading results from assigning to (1) an underlying structure in which the quantifier, all, is generated in the adjective phrase (structure (2b)).

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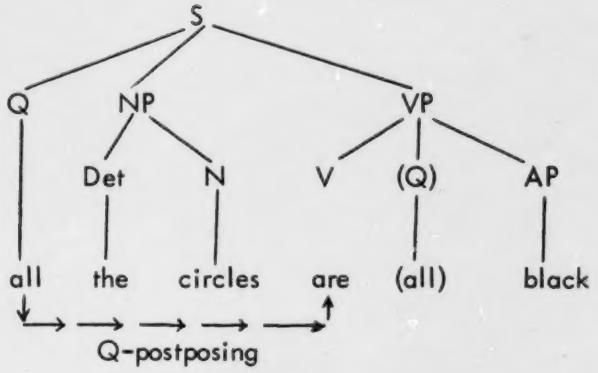
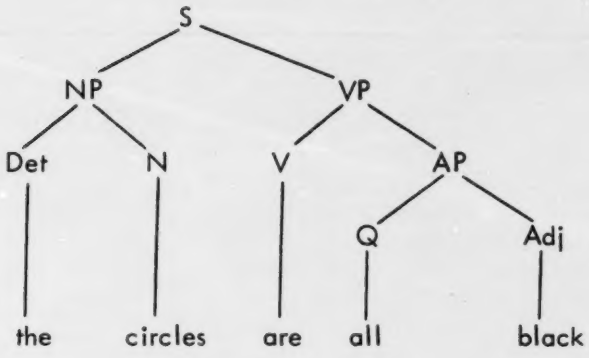
[1] Ray C. Dougherty, "A grammar of coordinate conjoined structures," Language 46. 4: 850-899. (December 1970).

Note that the all-circles interpretation involves a discontinuity in a semantically unified phrase. While discontinuities are avoided (e.g. many forms of embedded sentence) by adults and especially by children, one consequence of our analysis is the claim that discontinuities are tolerable in semantics. (For discussion of the syntactic facts see D. Slobin "Cognitive pre-requisites for the development of grammar" in Studies in Child Language Development ed. by C.A. Ferguson and D.I. Slobin (New York: Holt, Rinehart and Winston 1973); and N. Chomsky, "On the notion rule of grammar," p. 127 in The Structure of Language ed. by J. Katz and J. Fodor (Prentice-Hall 1964). If discontinuities are acceptable (or more tolerable) in semantics, this may suggest that semantic information is not subject to the same decay rate in immediate memory as syntactic information.

(2) a.



b.



It seems to be possible to "over-interpret," that is, to understand all (and certain other quantifiers) as occupying both possible positions: as a sentence quantifier and as a quantifier in an adjective phrase. This interpretation may not be strictly grammatical since, if pressed, people will opt for one interpretation or the other. It seems therefore, to be linked to some kind of performance factor in comprehension. This same effect of over-interpretation can be seen in (3) where sentence (a) may be interpreted as sentence (b):

(3) a. The students are 90% behind Sam.

b. 90% of the students are 90% behind Sam.

The traditional generative model of sentence comprehension claims, by contrast, that a speaker or hearer recovers a deep structure from a surface structure by determining where a constituent was moved from. The movement of any constituent may involve a shift of meaning. "Over-interpretation" involves giving a constituent (the quantifier) two meanings: the meaning it would have in the position where it originated and in the position to which it was moved. We might

add here that the notion of over-interpretation has never been discussed with reference to adults, but the phenomenon clearly exists and deserves recognition.

What relation does this have to acquisition? (1) Either children may also occasionally over-interpret, or (2) over-interpretation may be a systematic hypothesis about quantifier scope that they consider at some stage in their acquisition of the quantifier system.

METHOD

Children from three middle-class, Chicago schools, 202 altogether, from three to nine years old, were given a selection of 32 quantifier sentences. The children were tested in groups, for the most part, and individually if they were very young or very interesting. There were from 15 to 35 subjects in each age group. All of the sentences dealt with descriptions of circles and squares. In order to see if our results were affected by our choice of abstract objects, we asked a group of younger children and a few older children to do portions of the experiment with real objects that they could manipulate (some wooden animals and toy boats and fish). We found no differences between the groups.

The test itself consisted of this: we asked the children to mark certain objects, or one of six boxes, if it corresponded to the descriptions in the sentence we said to them. (See (4) next page for examples.) Finally, we gave the children some difficult sentences with multiple quantifiers:

(5) a. "Show me where some of the circles are all black."

b. "Show me where some of the circles are not all black."

When the description fit more than one box some children correctly marked more than one.

RESULTS

We shall only present those results that yielded an analysis. We hope further study and research will enable us to describe what occurs with other quantifiers (every, for example); but at present we have little that is systematic to say about them. The only general claim we can make is that all the children we tested appeared to understand every quantifier in isolation, that is, in a sentence with only one quantifier and one noun.

ALL

Our analysis of all is inconclusive by itself. However, our argument gains strength when we show its consistency with our data about some.

Let us characterize the two interpretations of all mentioned earlier as the adverb (all_1) and the adjective (all_2) interpretations. We call all_1 whose scope is circles the adverb interpretation because it seems to have been moved to where it is just as other adverbs are (see structure (2a)). For instance, unfortunately can be moved to a number of positions in (6) without a change in meaning:

(6) Unfortunately John (unfortunately) bought (unfortunately) a can of botulism tainted mushrooms (unfortunately).

We call all_2 adjectival (for convenience,) because it modifies the noun or adjective which it is next to. Adjectives must always be within the same constituent as the noun they modify. It is significant that quantifiers and adverbs seem to be "transportable" just to those positions that lie at the boundaries of major syntactic categories.[2]

In response to the sentence "all of the circles are black" 89% of the children chose Box V and 11% chose IV (from Box I-VI, see (4b)). None of them chose Box I where all of the circles were half-black; this could be a possible answer if the all were interpreted as referring exclusively to the set of circles and not to how much of them was black. A minority chose Box IV where some, but not all, of the circles were completely black. The majority chose V where every circle was completely black. In other words, most of the children preferred an interpretation which would be correct if all were in both of its possible positions; this preference increased with age.

At this point it is appropriate to mention that children often copy quantifiers spontaneously in their speech: "Only I want only this." If one quantifier appears there is a strong tendency for them to put it in initial position: "Only I need is this." The same phenomenon is a well-known occurrence with negatives. Children first place them in initial position: "No I do this;"[3] then after the subject: "I no do this;" and finally in several positions before they settle into the adult restrictions:

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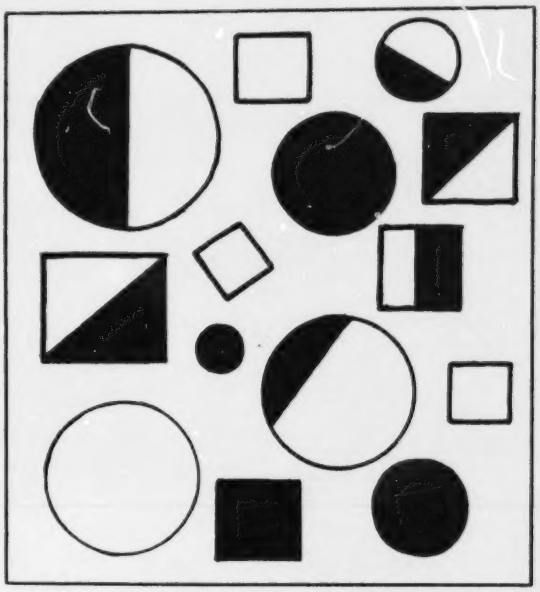
[2] As proposed by S.J. Keyser in "A review of Sven Jacobsen, Adverbial Positions in English," Language 44.2 (June 1971); R. Jackendoff, Semantic Interpretation in Generative Grammar, M.I.T. Press, 1972, and R. Dougherty, op.cit. However, it has been pointed out to us that they may also occur inside the AUX: they have all been drinking.

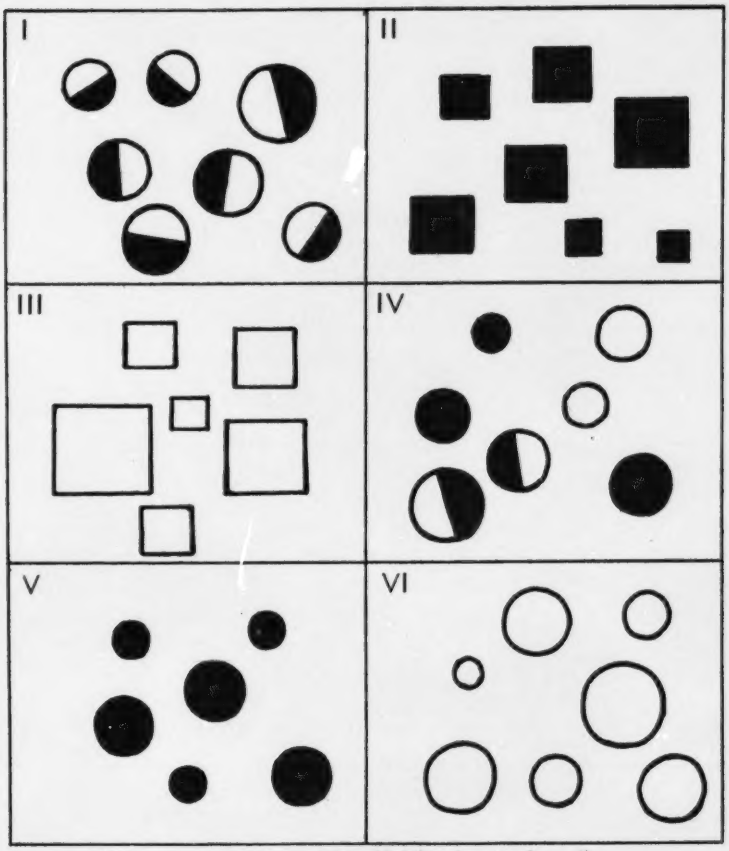
[3] See Paula Menyuk, Sentences Children Use, M.I.T. Press, 1969.

(4) a.



"Show me an all black circle."

(4) b.



"Show me a box with all black circles."

(7) "No, I not got no clothes on."

Spontaneous evidence, then, seems to support our claim that children distribute quantifiers to all possible positions at once.

Now we can return to the question of semantic interpretation. It is far from clear that children interpret the negatives in (7) as identical in meaning. Our evidence is consistent with this claim of a separate interpretation for each negative. In response to

(8) "The circles have no black.

78% of the preschoolers in our sample chose Box VI, and 11% took IV. By third grade 100% took VI. That is to say, the vast majority chose the box where none of the circles had any black. A few chose IV where only some of the circles had no black, and no other boxes were ever chosen. In sum, the negative may be said to have received a double interpretation: NEG the circles, NEG black (none of the circles have any black).[4]

Deep structure positions and over-interpretation. On the whole, the evidence we have seen suggests that children seek to represent both deep structure and derived structure in their utterances. This might be related to a stage in the acquisition of transformations.[5] Recent proposals by Jackendoff[6] suggest that deep structure itself should register possible positions without necessarily filling them. Our data appears to be very compatible with these accounts, and we conclude that over-interpretation operates on a syntactic tree by filling all possible positions that a quantifier or negative can occupy in deep or derived structure.

Counterarguments. One could retort that in the absence of an explicit quantifier in its initial position children just assume that an "all" box is better than a "some" box, i.e. that it is quite natural to choose a box where all of the circles are all black as an illustration of "the circles are all black." These claims seem both reasonable and correct to us, and our examples thus far have not proved that this could not be the case.

In fact, however, we have presented our argument in terms of all because it is easily comprehended in adult English. Adults can repeat all in two positions and give it either one interpretation or two interpretations. Notice, however,

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[4] Another possible interpretation (III) not the circles, but the squares did not occur with this sentence. It did suddenly occur with 1/3 of the first graders when they were given a double NEG sentence (None of the circles has any black). Their interpretation is as if circles were contrastively stressed and therefore focused. We were careful not to give contrastive stress. However, there is a more interesting possibility within this matter: it may be that the criteria for focus, hence contrast, were in a state of indeterminancy.

[5] T. Roeper, Approaches to a Theory of Language Acquisition with Data from German Children, unpublished Harvard Dissertation, 1972.

[6] R. Jackendoff 1972.

that the quantifier system is asymmetric: all, not, only (in some dialects) may be copied for emphasis with identical sense, but not every or some. "Some of the circles are green" does not mean the thing as "the circles have some green." Nor can both the some's in "some of the circles have some green" have the same interpretation. Some and every may not move. We know of no reason this asymmetry exists.

SOME

How does a child learn an asymmetric system? In most cases children learn regularities first and exceptions later. Often they will create regularity where there is, in fact, no regularity. One might therefore expect the child to treat all quantifiers uniformly, that is, she should treat all quantifiers as she treats all. An hypothesis emerges:

> (9) All children will pass through a phase where they will interpret a single quantifier as if it occurred in two positions with the scope unique to each position.

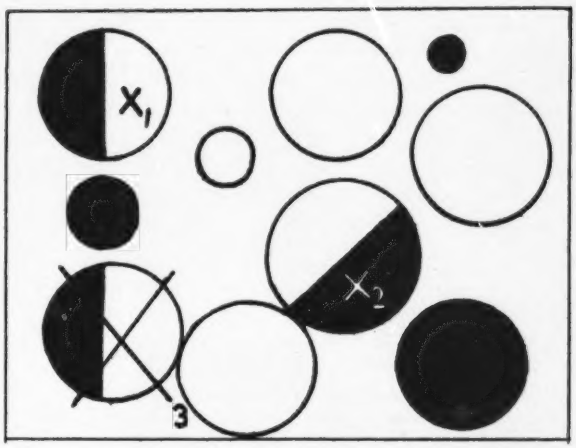
It follows from this that children will overgeneralize some to two positions. This is precisely what we believe we have found.

Two some's. First we will establish independent evidence for each use of some. We will call the some used with plurals extensive because it specifies the limits — the extension — of a subset of some set. In the course of our experiments we often heard the children use extensive some phrases spontaneously: "I want some crackers." They clearly meant to have several crackers, and they did not mean "I want some cracker," with the intention of getting a part of one. The "part of something" some we shall call the intensive some. This notion may be clearer if we look at another example: "In set A the things have some green on them." The some in this sentence is intensive; it is part of the adjective phrase which specifies that property which a thing must have to be a member of set A.

Double-some sentences. We have ample evidence that children understand both interpretations of some. Inadvertently, some children provided us with graphic proof. A group of the children had the habit of marking not the box as a whole which conformed to our description but the individual circles or squares in those boxes, as in (10) below. Thus, when we asked these children to show us a box with some black squares they marked either the half-black or the all black squares themselves. Fortunately, we had asked many of them to use crayons so their scrawls were visible even when they marked the black figures.

When we gave the children the double-some sentence "Some of the circles have some black," 70% of the preschool/ 1st grade group chose Box IV (which has some white, somehalf-black, and some all black circles). We did not always know that they meant by this choice. However, 13 out of the 14 who marked individual circles in IV marked half-black ones, see (10). This indicated that they had understood both some's. The markings on the individual circles indicated they had understood the intensive reading. That they chose IV and not I (except for 15%) showed that they were aware of the extensive reading because they picked the box where only some and not all of the circles had some black.

(10) IV



3 sample children: X_1, X_2, X_3

Our argument, if it is to parallel our argument about all, requires that we find a single-some sentence that receives a double-some interpretation. We gave the sentence "Some of the circles are black." This sentence was given before the double-some sentence discussed above in order to eliminate any effect that a preceding double-some sentence might have on the interpretation of a following single-some sentence. 88% of the LS children chose IV. This answer is correct because IV contains a number of completely black circles. But when we examined the responses of those who had marked the individual circles (in both LS and PS groups) we found that 80% (8/10) had, astonishingly, marked the half-black circles. In other words, they interpreted the single-some sentences exactly as if it had been the double-some sentence we discussed above. Notice again that had they interpreted some only once as extensive, they would have marked the all black circles in IV; and, had they interpreted it only as intensive, they would most probably have chosen I where all the circles fit the intensive description. We conclude that some is overgeneralized in precisely the same fashion as all.

In Bever's paper[7] on perceptual strategies he observes that very young children (2 1/2 years) understand passives, then misconstrue them (3 yrs.), and finally learn them again (3 1/2 - 4 yrs.). This anomaly can be accounted for if we assume that there is a period of overgeneralization of semantic knowledge as well as syntactic knowledge. His claim is that children overgeneralize the notion that the N-V-N order corresponds to actor-action-object no matter what other syntactic markers are present. Whether or not one agrees with his specific claim, the idea of semantic overgeneralization itself seems plausible. Our notion of semantic over-interpretation goes beyond a one-to-one mapping of syntactic elements onto semantic relations. The notion of over-interpretation suggests that non-manifest structure (i.e. deep structure) plays a role in children's semantic overgeneralizations.

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[7] T. Bever 1970, The cognitive bases of linguistic structures, in J. Hayes (ed.), Cognition and the Development of Language. Wiley.

A digression. It has been suggested to us by Carol Chomsky that children might distinguish between "s'm" and "some" where the vowelless "s'm" is interpreted as extensive and the "some" is interpreted as intensive. The suggestion is consistent with an hypothesis that may in general be important:[8] although children may see a derivational relation between two expressions they will nonetheless consider the hypothesis that every syntactic and phonological distinction may coincide with a semantic distinction. That is, the grammar is highly valued if syntactic, phonological, and semantic distinctions coincide. One is therefore justified in predicting that children will at one point hypothesize a semantic distinction between "s'm" and "some."

In our experiment we carefully pronounced the quantifiers fully although we equally carefully avoided giving them contrastive stress. We found both intensive and extensive interpretations. Thus, we found no evidence of a strict phonological mapping of the distinction. It may nevertheless be true that "s'm" is associated exclusively with the extensive interpretation for a time. And it may be that children do make such a phonological distinction in their own speech.

The intensive some. The use of intensive-some was not limited to the cases above; it seems to have a broader sort of cognitive fascination for children. In a few instances intensive-some was extended to every appearance of some. For instance in the early part of the test we sought to establish that all children comprehended single quantifiers, so we gave them sentences like these: Show me some black square or Show me some black squares. A surprising number of children chose half-black figures. They seem to have taken some to be a modifier of black which in turn modifies circles. This preference seems to occur just at the 1st grade level and neither before or after:

(11) Show me some black squares.

Subjects			
26	pre-school	34%	77%*
25	1st Grade	84%	12%
23	2nd Grade	12%	91%
30	3rd Grade	17%	83%

(* In all cases a small number of children chose both half-black and completely black squares.)

The intensive preference also appears in complex sentences. For instance, given the sentence: some of the circles have no black, 40% of the lower schoolers (a group of quite young — under four years -- of preschoolers who were given an abbreviated form of the test) chose Box I, and 60 % chose VI, while none took IV (which was correct). Of the pre-schoolers, one year older, 44% chose IV and none chose I. Those lower school children who took I seem to have analyzed the sentence as:

(12) [Some of the circle]s have no black.

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[8] T. Roeper 1972.

where the plural applies to the unit some of the circle. Thus they found the intensive-some interpretation compatible with a different parsing procedure.

It may be that the children's behavior is dominated by a larger cognitive strategy that is used in the analysis of the world itself. H. Sinclair-de-Zwart (personal communication) has noticed similar responses in the Piagetian experiments in Geneva.

What appears to be further evidence for children's preference for the intensive interpretation has been found by M. Donaldson.[9] She asked children to pick out one of two pictures that corresponded to the sentence: show me the picture where all the sand is in the jar. One of the pictures had an empty pan and a jar half full of sand. The other had a pan half full of sand and a jar completely full of sand. The children chose the picture with a full jar but a half full pan (therefore only some of the sand was in the jar). What the children seem to have understood was something closer to: the jar is all sand. That is, all was predicated intensively with respect to the jar and not with respect to sand as a plural quantity susceptible to distribution in different places. This interpretation of the Donaldson work was pointed out to us by C. Clifton.

Reversals. Throughout our data (12 of 20 sentences where some or not all appear) there is a curious reversal in ability to comprehend quantifiers at the pre-school/ 1st grade level. As in (11) the pre-schoolers and 2nd graders do not favor the intensive interpretation while the 1st graders do. Here are two more cases where we find this curious reversal:

(13) a. Some black circles

	I	IV	V
LS		100%	
PS	26%	33%	33%
1	37%	48%	4%
2	18%	48%	24%
3	13%	80%	
4	8%	89%	

b. All of the circles have some black

	I	IV	V
LS	63%	13%	25%
PS	22%	44%	33%
1	89%	4%	
2	70%	9%	15%
3	90%		10%

In (a) the pre-schoolers appear to choose randomly among three possible boxes. It is not clear what criteria they use; perhaps there is a conflict in criteria which is resolved differently by different children. In any case, something appears to be

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[9] "Some clues to the nature of semantic development" by M. Donaldson and J. McGarrigle, Journal of Child Language, Vol. 1, No. 2, 1974. This is the most recent of several papers dealing with this question. They discuss in particular the sentence All the cars are in the garage which, similarly, is interpreted as The cars are all in the garage. They attribute to children an attraction to the notion of fullness. They also give an extensive discussion of the relationship of these results to Piagetian conceptions.

happening just at this age. This apparent decrease in competence does correspond to the general pattern of growth with a period of overgeneralization when a new principle is learned. Perhaps this is a repetition of the kind of semantic overgeneralization reported by Bever for children learning passives. There too, the children appeared to control passives both at the earlier and the later stage but not in between. Further research is required before we can determine just what variables are involved.

Quantifier order. At this same age (PS/1st Grade) there is also an indication that order relations are unstable. Not all is suddenly given the interpretation of all not, and VI (all empty) is chosen instead of the correct IV (some empty) for sentence (14):

(14) Not all the circles are black

	I	IV	VI
LS	50%	50%	
PS	4%	33%	48%*
1	4%	67%	7%
2	18%	64%	18%
3	10%	73%	13%
4	6%	94%	

(*Less than 100% means some children did not respond.)

Almost half of the preschoolers chose box IV (all empty) while none of the lower schoolers did and almost none of the 1st-graders did. The effect of reversing the order of quantifiers is to make the negative a modifier of the larger phrase [all the circles] rather than simply all. In other words, the negative applies to the whole NP node — a higher node — rather than to the Q node, which is probably embedded in the Determiner. This may reflect a general tendency to attach adverbs and negatives to higher nodes — preferably to the sentence node itself.

This result appears to be regressive since it does not occur with the younger children in our sample. Suppose, however, we say that there is a general preference to negate entire propositions or just verb phrases (higher nodes). This preference cannot always be fulfilled. When children realize that elements can be moved, then order can be reversed, so that they can suddenly attempt to fulfill this general preference. This agrees with a notion of transformations as a device for simplification.

Notice that the order reversal phenomenon also occurs with adults:

(15) Every circle is not black.

Sentence (15) may receive two interpretations: every not (all aren't) or not every (one isn't, usually with heavy stress on every). This characteristic of some quantifiers in adult speech may be more general in children's speech.[10]

CONCLUSION

We have provided only a fragmentary account of children's comprehension of quantifiers, and we have used only a fragment of our data. Because our analysis is not complete, prudence would lead one to say that other factors might intervene that would disprove the analysis we have offered. For instance, our experiments involve translating from a verbal code to a visual scanning procedure. We found no obvious effects of this translation problem (despite considerable effort), but there could be some nonetheless. An ultimate understanding of these phenomena will no doubt require us to build interfaces between syntax, semantics, cognition, and perception. We continue to see syntactic structures as central structures in language to which other systems have manifold connections.

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[10] B. Partee has also suggested the possibility that children interpret the = all, or No Q = some (nothing in quantifier position equals some). Both all and some interpretations may occur for unspecified nouns in adult language. We hope to do further research on how children treat S's without Q's (e.g. Beavers build dams).